Outdoor Air Pollution & Health

Report to State Air Pollution Control Board

December 6, 2006

Mission Statement

This report is mainly about ozone and fine particulate matter

Review relevant medical, epidemiological and economic data related to health effects of outdoor air pollution

Present results about human health and health costs

Precursors & Sources

Ozone is formed in atmosphere when sunlight acts on VOCs and NOx

NOx and fine particulates that impact human health come from burning fossil fuels, mainly oil and petroleum

Major sources are on- and off-road vehicles, power plants and factories

Fine Particulates (PM10, PM2.5)

PM_{10} and $PM_{2.5}$ refer to particles with mean diameter of less than 10 and 2.5 microns, respectively.

$PM_{2.5}$ average 70% of PM_{10} by weight, but there are many more $PM_{2.5}$ particles

$PM_{2.5}$ are more hazardous to health, especially those produced by burning coal and petroleum

Particle Composition

Elemental and organic carbon, sulfur

Lead (diesel), selenium (coal), silicon (soil)

Other metals (iron, vanadium, nickel, copper)

Bacteria, virus, endotoxin

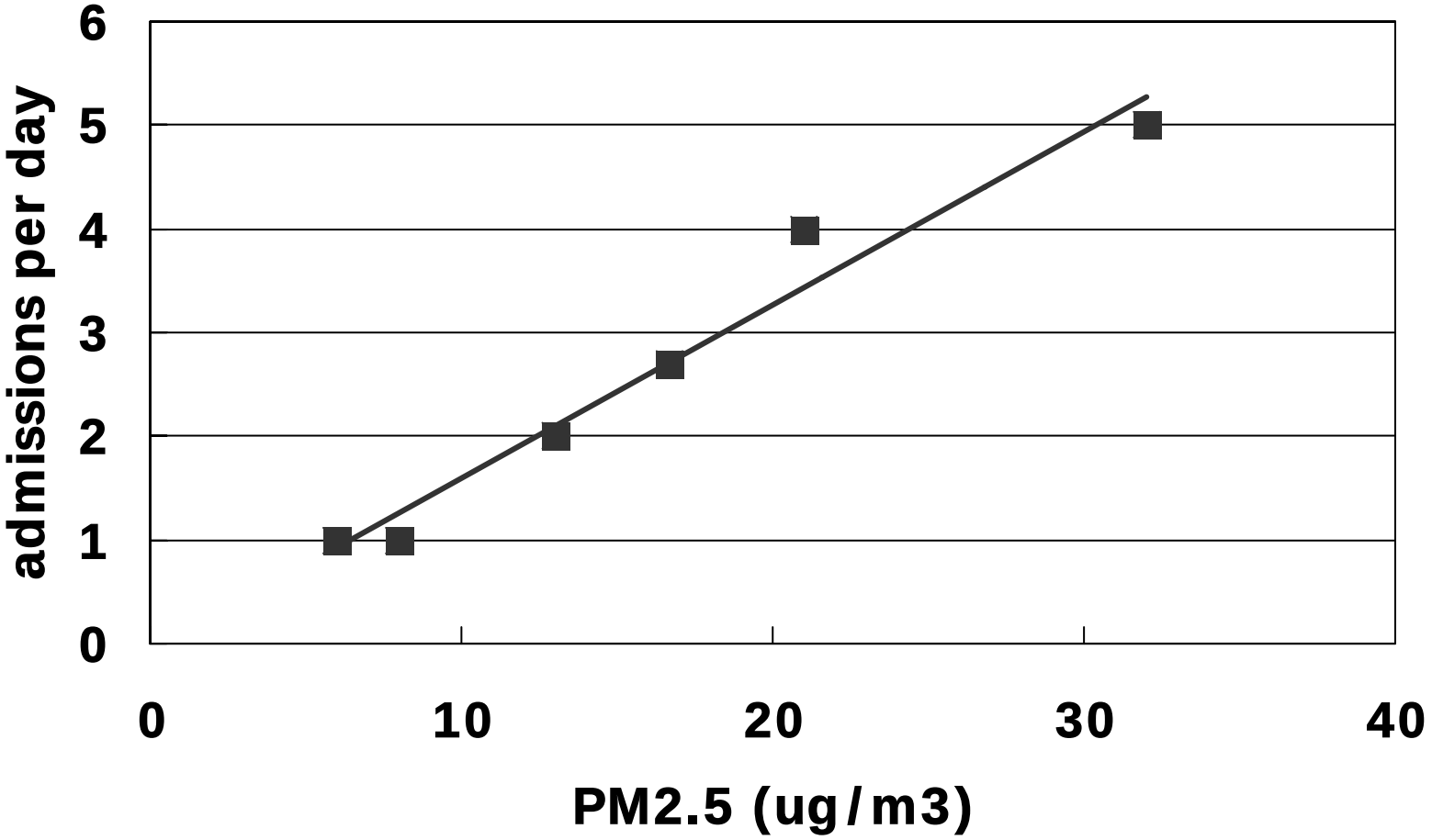
Long CM, Environ Health Perspect 2001; 109:1019-26
Laden F, Environ Health Perspect 2000; 108:941-47
Tanner R, J Air Waste Manag Assoc 2000; 50:1299-1307

Virginia Data, 2004 & 2005

Pollutant	*2004*	*2005*	*% change*
Ozone (ppb)	75	79	+ 5.3
PM_{10} ($\mu g/m^3$)	18.8	21.0	+ 11.7
$PM_{2.5}$ ($\mu g/m^3$)	13.2	14.1	+ 6.8

PM2.5 & Asthma Hospitalizations

Sheppard et al., Epidemiology 1999;10:23-30



Traffic & Illness

Heart attacks are related to traffic exposure

Children & adults close to a major highway have more respiratory symptoms

Mortality rates are higher in people who live adjacent to a major highway

Peters A et al., New Engl J Med 2004; 351:1721-1730

Garshick E et al., Epidemiology 2003; 14:728-736

Hoek G et al., Lancet 2002; 360:1203-1209

Kim JJ et al. Am J Respir Crit Care Med 2004; 170:520-26

Particulates & Mortality

Lung cancer

Heart attack & stroke

Infant mortality

Hoek G, Epidemiology 2002; 13: 491-92

Pope CA III Circulation 2004: 109:71-77

Hong YC, Stroke 2002; 33:2165-69

Ha EH, Pediatrics 2003; 111:284-90

Mortality From Ozone

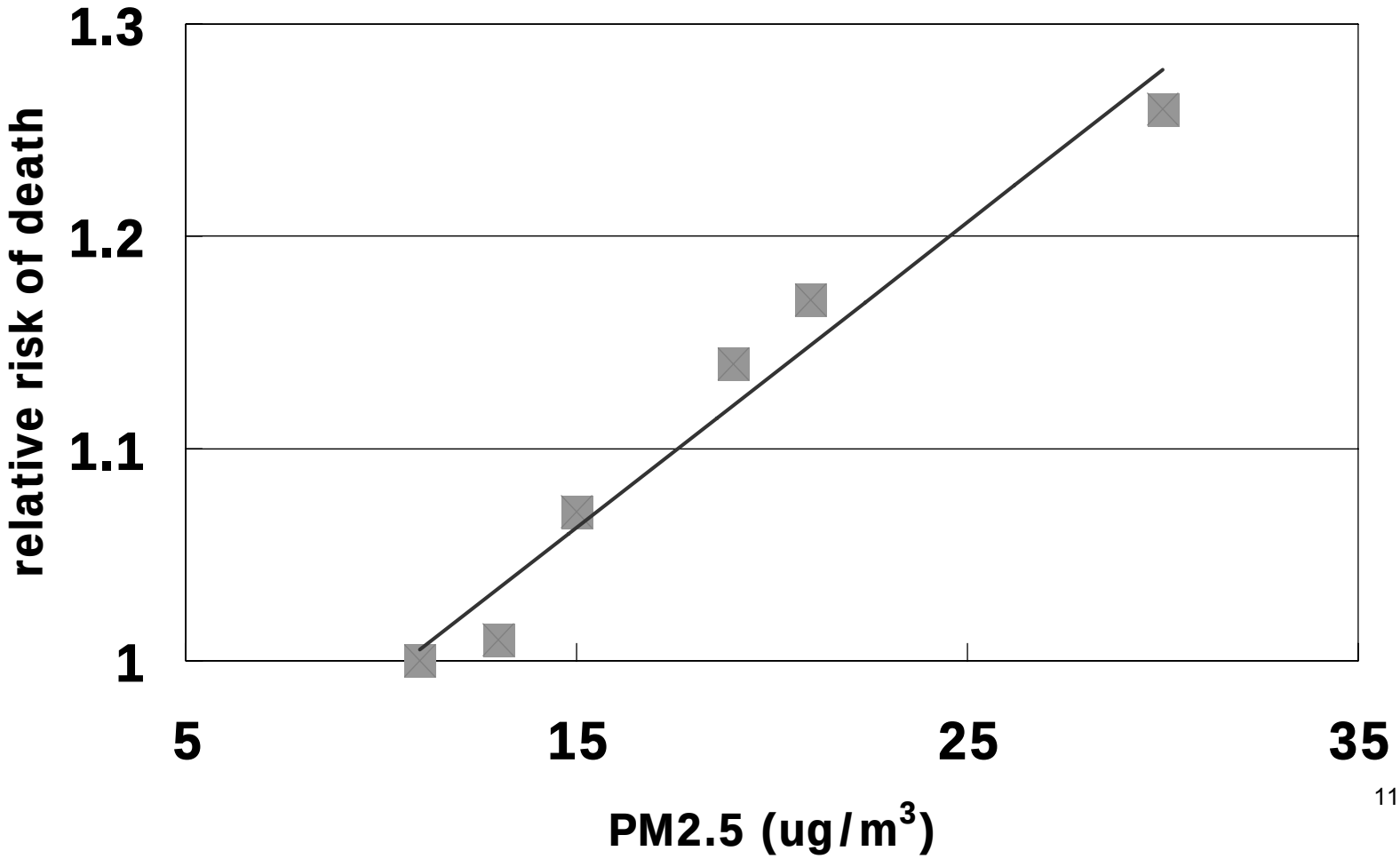
In summer months, a 10 ppb increase in ozone increases relative risk of dying by approximately 0.6 %

In Virginia, this comes to 15 premature deaths per 100,000 population

Gryparis A et al., Am J Respir Crit Care Med 2004; 170:1080-1087
Bell ML et al., JAMA 2004; 292:2372-2378

Particulates and Mortality in Six Cities

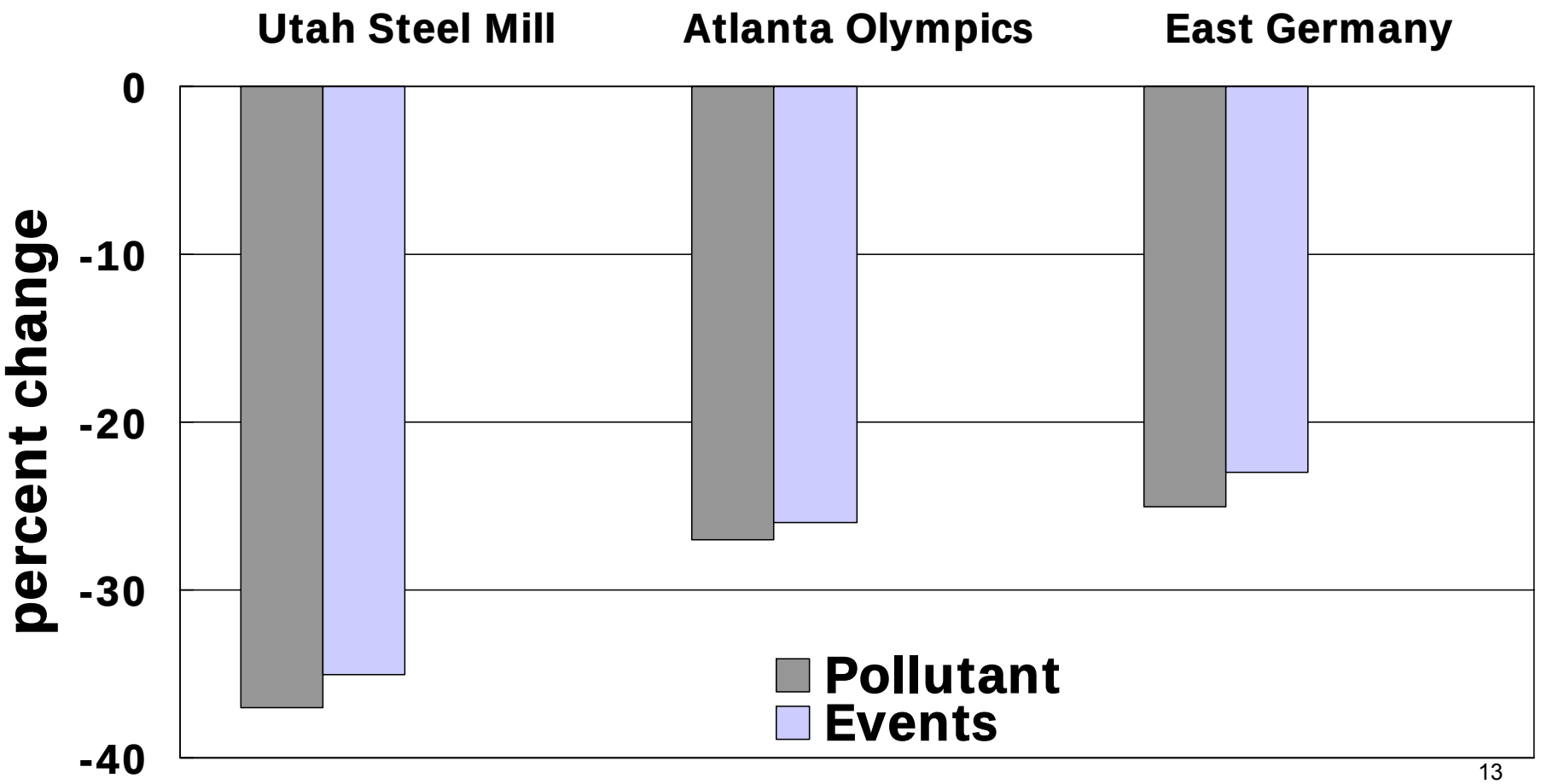
Dockery et al., NEJM 1993:329:1753-9



Comparative Death Rates

Cause	Rate/100,000	Percent
Tobacco	153	19
Air Pollution	69	8
Alcohol, cars, guns	57	7

Health Impact of Interventions



Pollution Abatement and Mortality

Black smoke concentration in Dublin fell 70% after home use of coal was banned

Cause of death	% reduction
non-trauma	5.7
respiratory	15.5
cardiovascular	10.3

Clancy L et al., Lancet 2002; 360:1210-14

Health Costs of Air Pollution

Health costs of air pollution average $800 per adult per year

In Virginia, this comes to $4.8 billion per year, approximately 1.6 % of GDP

Fuchs VR, Franks SR. Health Affairs 2000; 21:207-14
Levi JI et al. Environ Health Perspect 2001; 109:1215-26
Kunzli N. Eur J Respir Dis 2002; 20:198-209
Hall JV et al. Inst Econ & Environ Studies 2006

Cutting Air Pollution Health Costs

The cost of Medicare patient care is related to PM_{10} levels, even after correcting for income, race, obesity and smoking

A10 ug/m^3 reduction in PM_{10} would lower cost by $177 per person

Fuchs & Frank, Health Affairs 2002; 21:207-214

Impacts of Reducing Air Pollution

In Virginia, a 33% reduction in ozone and PM would be accompanied by:

33% reduction in childhood asthma

3% reduction in death rate

Over one billion dollars per year saved in health care costs

Improvements in Force or Pending

Cleaner power plants

Lower motor vehicle emissions

Cleaner fuels

Lower emissions for off-road engines

Recommendations: Home & Office

Insulate

Use heating, A/C and water sparingly

Less use of gasoline-powered yard equipment

Build “green” residential & office buildings

Use solar, wind and geothermal power

Recommendations: On- & Off-Road

On-road: Curtail excessive idling and lower speed limits

Tune engine, keep tires properly inflated

Minimize excessive acceleration and braking

Off-road: Regulate emissions

Require use of clean fuel